Intellectual Property Office of New Zealand
Te Pou Rāhui Hanga Hou

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 28 June 2002 with an application for Letters Patent number 519863 made by **Slab DSP Ltd.**

I further certify that pursuant to a claim under Section 24(1) of the Patents Act 1953, a direction was given that the application proceed in the name of **Phitek Systems Limited.**

Dated 7 July 2003.

Neville Harris
Commissioner of Patents

519863

nts Form # 4

SUBSTITUTION OF APPLICANT
UNDER SECTION 24

NEW ZEALAND

Patents Act 1953

PROVISIONAL SPECIFICATION

Title: Noise Cancellation System and Headphone Therefor

We, ***Slab DSP Ltd***,
Nationality: *A New Zealand company*.
Address: *Level 5, Elders Building, 2 Kitchener Street, AUCKLAND, New Zealand*,
do hereby declare this invention to be described in the following statement :

NOISE CANCELLATION SYSTEM AND HEADPHONE THEREFOR

FIELD OF THE INVENTION

This invention relates to noise cancellation systems, and is directed particularly, but not solely, toward a headphone noise cancellation system.

BACKGROUND OF THE INVENTION

Passenger vehicles, particularly commercial aircraft, have seat installations which include appropriate connections i.e. jacks for receiving connector plugs for headsets or headphones. The user either provides their own, or is provided with, a headset which the user plugs into the jack provided on the relevant seat to listen to various audio channels. The terms headset and headphone are used interchangeably in this document.

Recent developments to passenger audio systems include noise reduction systems. These use noise reduction headphones or headsets. In one system the seat installation includes active noise cancellation electronic circuitry. The circuitry is operative to provide noise cancellation based on feedback from an appropriate sound transducer such as a microphone which is provided within the headset.

One problem associated with such system is that the noise cancelling electronics needs to be "tuned" to the headset. Therefore, only one specific type of headset is generally able to be used with each of these systems.

OBJECT OF THE INVENTION

It is an object of the present invention to provide an improved noise cancellation system, or to provide an improved headset for a noise cancellation system, or to at least provide the public with a useful choice.

SUMMARY OF THE INVENTION

Accordingly, in one aspect the noise cancellation system having:

a headphone including a sound transducer

noise cancellation circuitry provided remote from the headphone, and

an output from the sound transducer of the headphone including a filter.

In a further aspect of the invention may broadly be said to consist of a noise cancellation system including

noise cancellation circuitry, and

a plurality of headphones, each headphone including a sound transducer and a filter at the output of the sound transducer to enable effective noise cancellation to be achieved in use.

In yet a further aspect of the invention may broadly be said to consist of a headphone for noise cancellation system, the headphone including,

one or more headphone speakers for providing sound to a user,

at least one sound transducer provided in the headset adjacent to the speaker, and

the output of the sound transducer being provided as an electric signal and being provided to a filter, and the output of the filter being available to noise cancellation circuitry to cancel noise from the signal being delivered to the speaker.

Preferably the filter comprises a passive filter.

Preferably the filter comprises a resistor capacitor network.

Preferably the sound transducer comprises an electric condenser microphone.

The invention also consists in parts, elements or features disclosed herein whether individually or in combination.

DRAWING DESCRIPTION

Figure 1 is a circuit schematic of a noise cancellation system according to the invention

Figure 2 is a schematic of an equivalent circuit for a headset microphone and filter according to the invention,

Figure 3 is a schematic for one example of a practical implementation of the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

In general terms, the invention provides a way of allowing noise cancellation circuitry which is typically provided remote from a headphone, to be able to provide effective noise cancellation for a number of different headphone designs. This is achieved by providing the noise cancellation headphone sound transducer (typically a microphone such as an electret condenser microphone) with a passive filter so that the feedback signal provided by the microphone is appropriately conditioned for a "generic" active noise cancellation circuit. Therefore, the invention allows the noise cancellation circuitry to be designed to be operative over a certain phase range of input feedback signals from a headset. This in turn means that the filter placed on the headset feedback signal may be appropriately configured for each different sort of headset so as to be acceptable to the noise cancellation circuitry and enable collective noise cancellation to be achieved.

The filter to which the feedback signal is provided in the headset can take a variety of forms. For example, it may be an active filter. The power supply for such a filter may be derived from a battery provided in the headset for example, or the power supply may be derived from the audio signal that is supplied to the headset itself. However, the most preferred form of the invention the filter comprises a simple passive filter. Most preferably it is a resistor capacitor filter as described further below. We have found that simple resistor capacitor passive filter provides an appropriate transfer function that is suitable for active noise cancellation applications. This simple passive filter may have the values of resistance or capacitance varied dependent upon the nature of the headphone, the headphone sound transducer etc.

Turning now to Figure 1, a schematic of an implementation of the invention as shown. The headphone is shown to the left of dashed line 2 in the figure and is generally indicated by arrow 4. On the other side of the drawing, i.e. to the right hand side of dashed line 2, the noise cancellation circuitry is shown generally referenced 6. By way of example, the noise cancellation circuitry may be provided in a portable electronic device such as a portable audio system including those sold under the trade mark WALKMAN. The circuitry could alternatively be provided in a home stereo system, a television set or a variety of other devices which provide sound to a user. However, more typically, the noise cancellation circuitry 6 will be provided in a passenger vehicle. Again, a number of different forms of passenger transport may be provided so the noise cancellation circuitry may be provided in a seat installation

(possibly an arm rest area) of a commercial aeroplane, a train, a bus, a private automobile, or the like.

In Figure 1, the sound transducer or the headphone 4 is an electric condenser microphone 8, and the output of the microphone is provided to a passive filter network comprising resistor 10 and capacitor 12. The output from the passive filter network is referenced 14 and 16, and these outputs are typically provided as pins on a plug which is acceptable to an appropriate jack or socket on the device that includes the noise cancellation circuitry.

Still referring to Figure 1, the headset 4 also includes a speaker 18 which has input signal connections 20 and 22. Again, connections 20 and 22 are in use electrically connected to an appropriate plug pins (not shown) so that they can be supplied with an appropriate electrical signal from the output of the noise cancellation circuitry that is provided in the corresponding socket remote from the headphone.

Turning now to the noise cancellation circuitry, the input to the noise cancellation circuitry from the microphone is represented by inputs 24 and 26. Input 26 may be a reference such as ground. Input 24 is provided to an amplifier 28 via capacitor 30. The power supply VCC and bias resistor 32 are also provided. The output of amplifier 28 is fed to noise cancellation circuitry which may comprise a passive network or be active, for example being implemented using a microprocessor. Noise cancellation circuitry which may be used is not described in this document as it is known to those skilled in the art. The output from the noise cancellation circuitry have been provided to an appropriate output amplifier 34 to be provided to output terminals 36 and 26 which connect to terminals 20 and 22 for the headphone speaker.

Turning now to Figure 2, further explanation of the passive filter network described above is illustrated. The sound transducer 8 in the preferred form of the invention comprises an electric condenser microphone. This microphone behaves as a current source from a signal viewpoint. Therefore, it appears to have a high impedance, so the filter circuit from the signal viewpoint can be represented as shown in Figure 2. In Figure 2, the microphone signal is represented as current source 40, the output of which is in series with a bias resistor Rbias. The current source and bias resistor are in parallel with the passive filter comprising resistor 10 and capacitor 12.

The network shown in Figure 2 provides a transfer function which is

$$\frac{1 + sRC}{1 + s(R + Rbias)C}$$

This is a suitable transfer function for active noise cancellation applications. i.e. the output from the circuit shown in Figure 2 is appropriate for provision to a "generic" active noise cancellation circuit.

Therefore, it can be seen that the values of resistance and capacitance of components 10 and 12 of Figure 2 may be chosen dependent upon the properties of the microphone used (i.e. the nature of the effective current source and resistance Rbias), together with other factors such as the general acoustic properties of the headphone e.g. shape and size of the ear piece and orientation of the microphone relative to the speaker.

Finally, in Figure 3, a typically implementation is illustrated. The reference numerals used in this figure are the same as those used with reference to Figure 1 and it can be seen that resistor 10 has value of 3.3kΩ, capacitor 12 is 68 nanofarads, and the bias resistor 32 is 4.7kΩ,.

From the forgoing, we see that the invention provides significant advantages in that a number of different headphones or headsets may be used to provide noise cancellation without having to redesign, alter or modify noise cancellation circuitry for which they are used. Therefore, noise cancellation circuitry may be designed to standard parameters and embodied in various devices such as personal stereos or passenger seat installations while allowing users to use their own preferred headset, or a variety of different headsets.

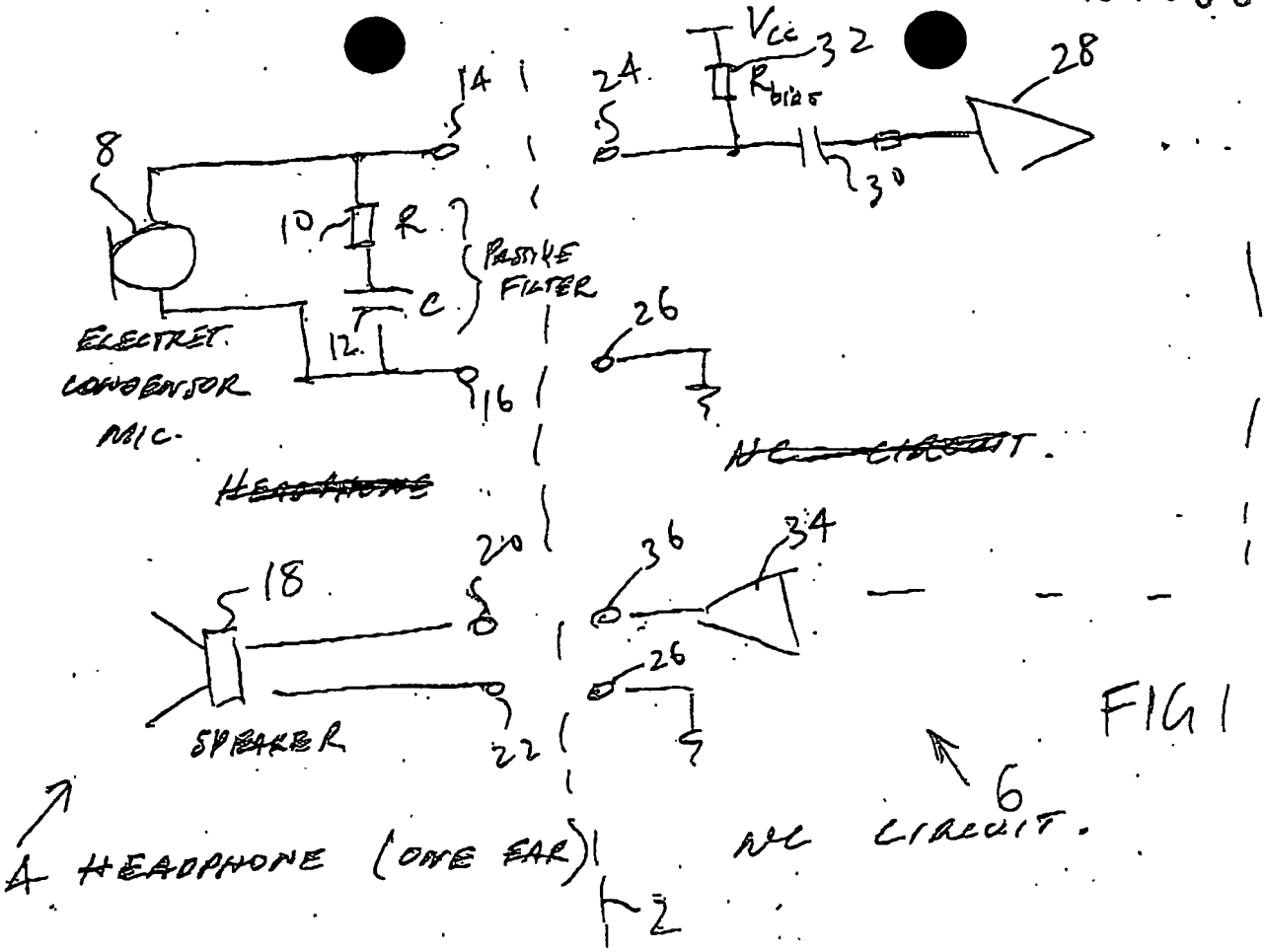

FIG 1

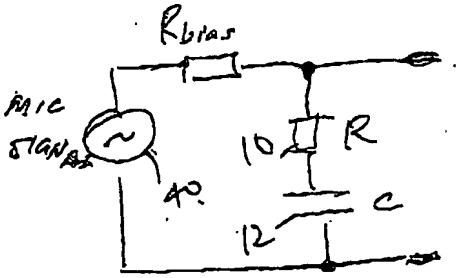

FIG 2

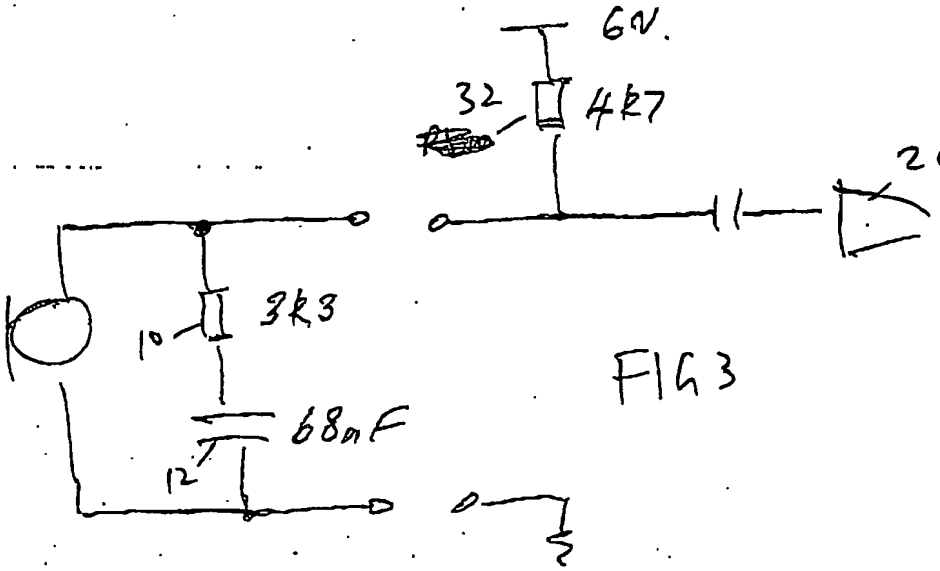

FIG 3